REMARKS

In the office action, the examiner rejected Claim 4 under 35 U.S.C. 112, second paragraph, as being indefinite failing to particularly point out and distinctly claim the subject matter of the invention. It is stated that it is not clear how the central angle is defined or measured. Accordingly, the applicant has amended Claim 4 and the specification to more clearly describe the central angle. For example, in the paragraph [0041], the applicant has added correct the recitation of "Here, as shown in Fig. 2(a), the central angle θ is an angle between a first line connecting a center of the first radius R1 and the axis O and a second line connecting the center of the first radius R1 and the connection point P. Substantially the same recitation except for the reference characters and numbers has been added to Claim 4 to overcome the rejection under 35 U.S.C. 112, second paragraph. This feature is clearly supported by the original disclosure of the instant application, for example, in Figure 2(a).

In the office action, the examiner rejected Claims 9 and 10 under 35 U.S.C. 102(b) as being anticipated by Giessler et al. (U.S. Application Publication No. 2004/0105729). The examiner rejected Claims 3-8 under 35 U.S.C. 103(a) as being unpatentable over the Kolker et al. (U.S. Application Publication No. 2005/0025584). Accordingly, the applicant has amended the claims to more clearly differentiate the present invention from the technologies disclosed by the cited references.

More specifically, the applicant has corrected the recitation regarding the direction of view in Claims 3 and 9 as "wherein said second portion is defined by a circular arc which is convex in said direction of the rotation of said tool body and which has a second radius of curvature as ~~measured~~ seen in the distal end view ~~perpendicular to said axis~~, said second radius of curvature ~~being~~ is larger than said first radius of curvature. In other words, there was an inconsistency in the description regarding the direction of view in defining the shape of the ball endmill since the terms "perpendicular to said axis" contradicts the terms "in the distal end view". Accordingly, the applicant has deleted the terms "perpendicular to said axis" from Claims 1 and 9 so that the direction of view is the --distal end view-- which is a view seen in the direction of the axis. This amendment is clearly supported by the original disclosure of the instant application, for example, at paragraphs [0031] and [0032] with reference to Figs. 1 and 2, which reads as follows:

> **[0031]** In a distal end view seen in a direction (indicated by arrow Ib in view (a) of Fig. 1) of the axis O of the ball endmill 1, as shown in view (b) of Fig. 1, each of the ball-nosed end cutting edges 6a-6c extends from the outer periphery to the axis O, and has an arcuate shape which is convex in a direction of rotation of the ball endmill 1 (in the counterclockwise direction as seen in view (b) of Fig. 1). The ball-nosed end cutting edges 6a-6c will be described in detail with reference to Fig. 2.
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> **[0032]** Fig. 2 is a set of schematic views schematically showing the distal end portion of the ball endmill 1, wherein view (a) of Fig. 2 is the schematic view obtained by projecting the ball-nosed end cutting edges 6a-6c onto a plane, and view (b) of Fig. 2 is the

enlarged schematic view showing in enlargement a part of view (a) of Fig. 2. It is noted that an outer peripheral portion of each ball-nosed end cutting edge 6 is not illustrated in view (b) of Fig. 2.

In the ball endmill of the present invention defined in Claims 1 and 9, each of the ball-nosed end cutting edges includes the first and second portions having the respective first and second radii of curvature which are different in value from each other in the distal end view seen in the direction of axis. This unique construction causes a cutting resistance (cutting torque) exerted by a workpiece, to act in the directions that are different in the first and second portions of each ball-nosed end cutting edge. As a consequence, vibrations are canceled with one another, thereby making it possible to restrain the vibration. None of the cited references show this unique structure and effects of the present invention as discussed below.

The cited Giessler et al. reference (U.S. Application Publication No. 2004/0105729) discloses a drilling or milling tool with a shank and a cutting part, the cutting part having cutting grooves running helically along its periphery and extending to the end face of the cutting part and also having, at its end face, cutting edges which are formed where the cutting-grooves intersect the end face of the tool. The helix angle of the cutting grooves, measured relative to a plane containing the tool axis, is greater than the angle, measured at a corresponding plane, of the cutting faces adjoining the end-face cutting edges.

In the office action, the examiner stated that the cited Giessler et al. reference shows the feature of the present invention "a first portion extending from said axis and provided by a radially inner portion of each cutting edge and a second portion contiguous to the first portion and provided by a radially outer portion of each cutting edge, and a first radius of curvature of the first portion is smaller than a second radius of curvature of the second potion" with reference to Fig. 3b and paragraph 29. However, what is described by the paragraph 29 and Fig. 3b is a structure and curvatures of the drilling tool seen in the direction perpendicular to the axis (front view) which is the same as that of Fig. 1 showing the whole view of the tool. In fact, the paragraph 29 clearly shows that Fig. 3b is an enlarged view of the encircled area of Fig. 3a which shows the view of the drilling tool in the same direction as that of Fig. 1, which reads as follows:

> [0029] The present invention relates above all to the design of the radial cutting edges 4 or to the cutting faces located at the cutting edges 4. This pattern is shown more precisely in FIGS. 3a-3c. FIG. 3a shows the lower section of the milling cutter represented in FIG. 1, wherein a chamfering 6 of the outer corner transitions between the end face and the peripheral surface of the milling cutter. In FIGS. 3b and 3c, the lower end section of the main cutting edges 5, 5A is represented for two different embodiments respectively, in a view corresponding to the encircled area of FIG. 3a. As can be seen, the main cutting edge 5, 5A runs inclined to the axis 7 of the milling cutter at an angle δ_{p2} which, as already mentioned, is designated the helix angle....

As clearly defined in Claims 1 and 9, the first portion and the second portion as well as the first radius of curvature and the second radius of curvature are defined in the distal end view seen

in the direction of axis. As shown in Figures 2(a) and 2(b) of the present invention, this direction of view is completely different from the direction of view of Fig. 3b of the cited Giessler et al. reference which is a view seen perpendicular to the axis. Therefore, the cited Giessler et al. reference does not show or suggest the essential feature of the present invention.

The cited Kolker et al. reference (U.S. Application Publication No. 2005/0025584) discloses a face milling cutter that enables a high feed rate with a high removal rate and with low stress on the individual cutting edges. It is stated that the face milling cutter is especially suited for roughing work in the field of mold and die production and that the shaft section and tool section can be formed from one piece of carbide. It is stated that, alternatively, the cutting edges can be formed on a separate die plate, which is attached to the tool shaft in a detachable manner. The tool section has at least one lower cutting edge, one corner cutting edge attached to this, as well as a peripheral cutting edge. Corresponding cutting edges are provided in a diametrically opposed manner.

In the office action, the examiner stated that the cited Kolker et al. reference shows the feature of the present invention "a first portion extending from said axis and provided by a radially inner portion of each cutting edge and a second portion contiguous to the first portion and provided by a radially outer portion of each cutting edge, and a first radius of curvature of

the first portion is smaller than a second radius of curvature of the second potion" with reference to Figs. 4 and 5 and paragraph 28. However, similar to the discussion above with respect to the cited Giessler et al. reference, what is described by the paragraph 28 and Figs. 4 and 5 of the cited Kolker et al. reference is a structure and curvatures of the face milling cutter seen in the direction perpendicular to the axis (lateral view, i.e., front view) which is the same as that of Figs. 1, 1A and 2. The paragraph 28 clearly describes that an enlarged lateral view of Fig. 4 shows the lower cutting edge 24 and the corner cutting 26 with different radius of curvature, which reads as follows:

> [0028] The blade 18 consists of a lower cutting edge or front cutting edge (24), a corner cutting edge 26, and a peripheral cutting edge 28. The latter is straight in cross-section and recedes by a clearance angle a with respect to a tangent (30) on the circular corner cutting edge 26. The tangent 30 describes a flight circle with a diameter d1, to which all other measurements given below refer. The cutting edge 24 is formed with a radius from 1 to 2 times d1. In this specific case, the radius r1=1.5 times d1. The center of the circular arc lies shifted opposite the tool axis 28, as it were, by a magnitude of 0.2 to 0.4 times d1....

As clearly defined in Claims 1 and 9, the first portion and the second portion as well as the first radius of curvature and the second radius of curvature are defined in the distal end view seen in the direction of axis. As shown in Figures 2(a) and 2(b) of the present invention, this direction of view is completely different from the direction of view of Figs 1, 4 and 5 (lateral views) of the cited Kolker et al. reference. Therefore, the cited Kolker et

al. reference does not show or suggest the essential feature of the present invention.

As discussed above, none of the cited references show the essential features of the present invention. Thus, the applicant believes that the rejection under 35 U.S.C. 102(b) based on the cited Giessler et al. reference is no longer applicable to the present invention. Further, the applicant believes that the rejection under 35 U.S.C. 103(a) based on the cited Kolker et al. reference is no longer applicable to the present invention.

In this opportunity, the applicant has amended the specification and the abstract to improve the readability thereof and to correct minor wording problems therein. This is to verify that no new matter has been introduced by this amendment.

In view of the foregoing, the applicant believes that the instant application is in condition for allowance, and accordingly, the applicant respectfully requests that the present application be allowed and passed to issue.

Respectfully submitted,

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